L9 Predicting the Number of Roots of Quadratics

Recall: For a quadratic relation
roots = zeroes = x-intercept = solutions

Given vertex form, look at:
- the location of the vertex (above/below x-axis?)
- the direction of opening (up/down?)

Ex.1 $y = 3(x - 5)^2 - 1$

V(5 , -1)

The vertex lies **above/below?** the x - axis.

The parabola opens **up/down?**

zero(es): 2

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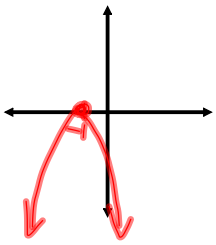
Ex.2 $y = -2(x + 1)^2$

V(-1 , 0)

The vertex lies on the x-axis

zero(es): 1



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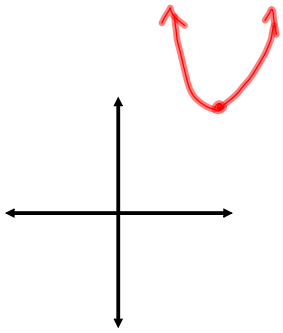
Ex.3 $y = 3(x - 5)^2 + 6$

V(5 , 6).

above/below? the x-axis

opens **up/down?**

zero(es): none



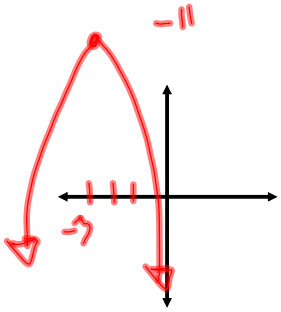
Ex.4 $y = -0.5(x + 3)^2 + 11$

V(-3 , 11).

above/below? the x-axis

opens **up/down?**

zero(es): 2



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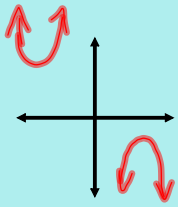
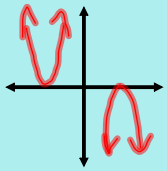
In general to identify the zeros from vertex form:

There will be 0 zeroes if the vertex is above the x-axis and the parabola opens up

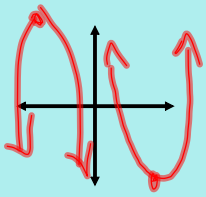


OR if the vertex is below the x-axis and the parabola opens down

There will be 1 zero if the vertex is on the x-axis



There will be 2 zeroes if the vertex is above the x-axis and the parabola opens down



OR if the vertex is below the x-axis and the parabola opens up

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What if the quadratic is in standard form?

1. Factor and find the number of roots directly.

2. Complete the square (vertex form) and deduce the number of roots by visualizing the graph.

3. Use the quadratic formula if:
   - it cannot be factored
   - the numbers are too difficult to work with

Ex.1 Use the quadratic formula to determine the zeroes.

(a) $-2x^2 - 4x - 2 = 0$

$a \quad b \quad c$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(-2)(-2)}}{2(-2)}$$

$$x = \frac{4 \pm \sqrt{0}}{-4}$$

root(s): 1

root(s): -1

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(b) $y = 3x^2 - 30x + 74$

$a \quad b \quad c$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$X = \frac{-(-30) \pm \sqrt{(-30)^2 - 4(3)(74)}}{2(3)}$$

$$X = \frac{30 \pm \sqrt{12}}{6}$$

$\frac{30 + \sqrt{12}}{6} \Rightarrow X_1 = 5.58$

$\frac{30 - \sqrt{12}}{6} \Rightarrow X_2 = 4.42$

root(s): 2

root(s):

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(c) $y = 3x^2 - 30x + 81$

$a \quad b \quad c$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$X = \frac{-(-30) \pm \sqrt{(-30)^2 - 4(3)(81)}}{2(3)}$$

$$X = \frac{30 \pm \sqrt{-72}}{6}$$

root(s): none

root(s):

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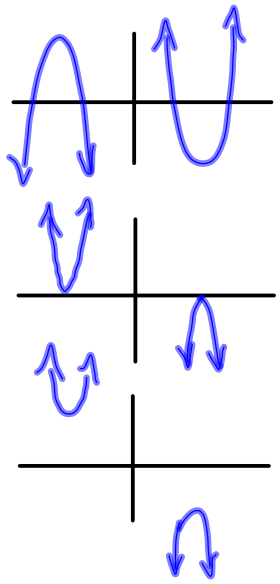
$D = b^2 - 4ac$ is called the discriminant. $2x^2+4x+7$

It tells you how many zeros the quadratic has.

D is positive $b^2 - 4ac > 0$	two real roots
D is zero $b^2 - 4ac = 0$	one real root (double root)
D is negative $b^2 - 4ac < 0$	no real roots



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Ex.2 Find how many zeros each of the following quadratic relations has using the discriminant.

(a) $y = x^2 - 6x + 7$ $D=b^2-4ac$ $=(-6)^2-4(1)(7)$ $=36-28$ $=8$ two real roots

(b) $y = 2x^2 - 5x + 9$ -47 none

(c) $y = x^2 + 3x - 11$ 53 two real roots

(d) $y = 9x^2 - 24x + 16$ 0 One real root

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Assigned Work:

p.350 # 2, 3def, 4, 5, 7, 9, 10, 12

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